

nomena in which sources and sinks are temporally dynamic (spreading of risk).

GIS ANALYSIS OF LAND-USE PATTERNS AND NESTING DENSITY OF SWAINSON'S AND RED-TAILED HAWKS IN NORTHERN UTAH

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A total of 30 red-tailed hawk (*Buteo jamaicensis*) nests and 28 Swainson's hawk (*B. swainsoni*) nests were discovered in Cache Valley, Utah, during the summers of 1992 and 1993. All nests were found in trees, but red-tailed hawks more often nested in dead trees. GIS analysis of land-use patterns was made for 1-km radius around nest sites. Results revealed that overall land-use at nest areas was dominated by cropland, alfalfa, and pasture, but no significant differences were found between species. Red-tailed hawk nests were surrounded by greater areas of riparian areas and fallow fields. Swainson's hawk nests were surrounded by significantly greater areas of industrial/commercial zones. Despite this difference, distance to the nearest paved road and building was very similar for both species implying that little difference exists in the tolerance levels for human activities. In the intensive study area, ecological nesting densities (minimum convex polygon method) were 2.56 km²/nest for Swainson's hawk and 6.35 km²/nest for red-tailed hawk. Nearest neighbor distances were 1.52 km for Swainson's hawk nests and 2.88 km for red-tailed hawk nests. The only clear management strategy favoring Swainson's hawks would be to keep tree densities down or manage open lands away from riparian zones.

NEST-SITE SELECTION AND REPRODUCTIVE PERFORMANCE OF URBAN NESTING SWAINSON'S HAWKS IN THE CENTRAL VALLEY OF CALIFORNIA

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In the last 5 yr, Swainson's hawks (*Buteo swainsoni*) have been regularly observed nesting in urban settings in Davis, Stockton, and Woodland, California. These Central Valley communities are small- and medium-sized cities surrounded by agricultural crops used as foraging habitat by Swainson's hawks; distance to foraging habitat is typically <5.0 km. Urban nesting hawks select nests in three settings: (1) large, non-native trees in neighborhoods greater

than 50 yr old; (2) smaller, non-native trees with dense canopies (primarily conifers) in neighborhoods 20–40 yr old; and (3) remnant riparian or oak woodland trees that existed prior to development. Preliminary analysis of the number of young fledged per occupied nesting territory does not indicate a statistically significant difference ($P > 0.05$, Kruskal-Wallis ANOVA by ranks) between nests in urban, rural, or edge settings. Similar, but unoccupied, urban nesting habitat is located in older neighborhoods in the Central Valley communities of Lodi and Sacramento, small and large communities respectively. These potential nesting areas are surrounded by large expanses of either vineyards (Lodi) or urban development (Sacramento); neither are suitable Swainson's hawk foraging habitat. In both instances, distance to foraging habitat is typically >8.0 km. The results of this analysis suggest that the success of urban Swainson's hawk nesting territories in Davis, Stockton, Woodland, or other Central Valley cities may decline as distance to foraging habitat increases.

OVERVIEW OF SWAINSON'S HAWK POPULATION STATUS AND NATURAL HISTORY

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Swainson's hawks (*Buteo swainsoni*) were originally birds of open savannah-steppe, where nesting habitat of large trees was surrounded by foraging habitat with prey of small mammals, some birds and large insects. The conversion of large areas of western North America to agriculture has changed much habitat, and Swainson's hawks have adapted in both breeding and foraging habits. Compatible agriculture for foraging now includes pasture, sugarbeets and alfalfa cropland, plus newly harvested fields of several crops, and foraging areas are often at considerable distance from nesting areas. Some agriculture-adapted Swainson's hawks have adopted urban breeding locations, nesting in trees in towns and cities in central California. Drought, and its effect on prey populations, has had a cyclical negative effect on Swainson's hawk populations throughout their breeding range in nonirrigated areas. Where conditions are favorable, there is evidence that individual birds do shift to foraging in agricultural areas when natural prey populations drop. However, despite some populations showing adaptation to human encroachment and a shift in foraging to agriculture, a significant loss of breeding populations has occurred. Much loss has been due to urbanization and loss of all suitable foraging habitat, but populations have also been extirpated from some apparently suitable habitat, possibly correlated with long-term rodent control programs.

ECOLOGICAL RELATIONSHIPS BETWEEN NESTING SWAINSON'S AND RED-TAILED HAWKS IN SOUTHEASTERN IDAHO